NAVSHIPS 93630(A)

TECHNICAL MANUAL

FOR

For

RADIO SET CONTROL

C-2099A/FRC-52

COMMUNICATIONS COMPANY, INC.

CORAL GABLES, FLORIDA

NAVSHIPS 93630 (A)

TECHNICAL MANUAL

For

RADIO SET CONTROL

C-2099A/FRC-52

COMMERCIAL MODEL NUMBER

297-6H

COMMUNICATIONS COMPANY, Inc.
300 Greco Avenue
Coral Gables, Florida

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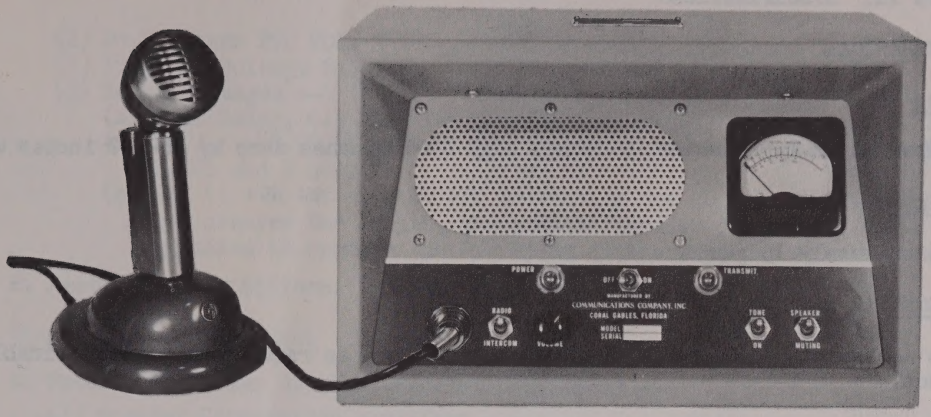

Figure 1-1. Front View of Control Radio Set C-2099A/FRC-52, With Microphone

SECTION I. DESCRIPTION

A. DESCRIPTION

The CONTROL RADIO SET, C-2099A/FRC-52 (COMCO Model 297-6H) is engineered and designed in accordance with the requirements of the applicable contract.

The C-2099A/FRC-52 is a desk mount type, designed for remote control of a radio telephone receiver and transmitter. Two or more control units may be operated in parallel with inter-communication (without transmission) between control units. Remote control is accomplished over a single pair, metallic, telephone line and an earth ground. More specifically, a standard two-wire 600 ohm telephone line having a total loop resistance of not over 1500 ohms.

While designed primarily for the remote control of Navy Models AN/FRC-52( ) and AN/FRC-70( ) equipments and various COMCO commercial models of VHF-FM and VHF-AM aeronautical ground equipment, it is equally applicable for controlling similar two-way radio telephone stations using A-3 (AM) or F-3 (FM or PM) emission having a single receiver and transmitter located at a remote location. It is designed primarily for voice communication. The C-2099A/FRC-52 furnishes voltage for Push-to-Talk operation of the remote transmitter. It meets F.C.C. requirements for remote transmitter control.

B. COMPRESSION AMPLIFIER(S)

A pair of Compression Amplifiers (one each for transmit and receive) are included in this remote radio set control unit. The performance of these compression amplifiers is in accordance with the requirements of the applicable contract.

C. LEASED LINES

Three classes of leased lines are usually available. These are explained more fully in Section V, Paragraph B, of this Technical Manual.

SECTION II. SPECIFICATIONS

A. MECHANICAL

1. Size

A desk mount type cabinet 9 inches high by 10 inches deep by 14-1/2 inches wide.

2. Weight

Approximately 15 pounds.

3. Finish

The cabinet is finished in a light-gray enamel, as required by the applicable contract.

B. ELECTRICAL

1. Compression Amplifier

This remote radio set control incorporates compression amplifiers having the capability with respect to a variation of 25 db (or more) in the audio input level, of limiting the audio output level to less than 3 db variation. This capability is effective in both the transmit and receive conditions.

2. Transmit Conditions

a. Input — Controlled Reluctance, Transistorized Pre-Amplifier, microphone; or an audio tone oscillator within a frequency range of 800 to 1000 cycles.

b. Output — 500/600 ohms (balanced to ground).

c. Output Level — Into a 600 ohm telephone line, up to 50 milliwatts, normal maximum level 18 milliwatts with less than 5% distortion.

d. Audio Response — ± 3 db from 300 to 3000 cycles (controlled by the compression amplifier).

e. Hum and Noise Level — At lease 40 db or more below the rated output level.

3. Receive Condition

a. Input Impedance — 500/600 ohms (balanced to ground).

b. Minimum Input — Required over a 600 ohm telephone line for 1 watt of speaker level, -10 db (or lower).

c. Output Impedance(s) — 3.5 and 500 ohms (unbalanced).

d. Speaker Output — At least 2.0 watts with less than 5% distortion.

e. Audio Response — ± 3 db from 300 to 3000 cycles (controlled by the compression amplifier).

f. Hum and Noise Level — At least 45 db or more below the rated output level of 2.0 watts.

4. Power Supply

a. AC Input — 110 to 120 volts, 50 to 60 cycles, Single Phase.

b. Output Voltages —

(1) B+ Voltages 250 VDC.
(2) Filament Voltage 6.3 VAC.
(3) Relay Voltages —
(a) Tone Relay, 6.3 VAC, for operation of K 402.
(b) P/T ', -48 VDC (key down) to -55 VDC (key up) for the operation of K 401 and K 403.
(c) P/T ", +24 VDC to +60 VDC (variation due to telephone line length, the greater the length, the greater the loss). This voltage is supplied to operate the P/T relay at the remote transmitter.

c. Rectifiers — Silicon.

5. Electron Tube Complement

a. Speaker Amplifier Section (Receive Condition) —

(1) Speaker Compression Amplifier - - - - - - - - - 6BA6
(2) Speaker Compression Bias Rectifier- - - - 1/2-6AL5
(3) Speaker Amplifier - - - - - - - - - - - - - - - 6C 4
(4) Speaker Output Amplifier- - - - - - - - - - - 6AQ5

b. Microphone Amplifier Section (Transmit Condition) —

(1) Microphone Pre-Amplifier- - - - - - - - - 1/2-12AT7
(2) Microphone Compression Amplifier- - - - - - - 6BA6
(3) Microphone Compression Bias Rectifier - - 1/2-6AL5
(4) Microphone Amplifier- - - - - - - - - - - - - 6C 4
(5) Microphone Output Amplifier - - - - - - - - - 6135

c. Tone Oscillator Circuit (Transmit Condition) —

(1) Audio Tone Oscillator - - - - - - - - - - - 1/2-12AT7

6. Operators' Controls and Indicators (Mounted on the Front Panel)

a. POWER OFF-ON Switch.

b. RADIO/INTERCOM SWITCH (momentary type; locking in the RADIO position, non-locking in the INTERCOM position).

c. Speaker Volume Control.

d. Speaker OFF-ON Switch (momentary type, locking in the ON position, non-locking in the OFF position).

e. Attention TONE Switch (momentary type, locking in the OFF position, non-locking in the ON position). Operates P/T Relays and provides tone signal.

f. Power ON Light.

g. "Talk" or TRANSMIT light.

h. Loudspeaker (3.5 ohms impedance).

i. VU Line Level Meter (- 20 to + 3 VU).

SECTION III. OPERATION

A. PRELIMINARY

It is assumed that, before being assigned to the operating personnel, the Remote Radio Set Control, C-2099A/FRC-52 (COMCO Type 297-6H) will have been installed and all the necessary adjustments made according to the instructions given in Section V of this Technical Manual. These adjustments include the setting of the microphone gain, output level and input level controls.

B. DESCRIPTION AND LOCATION OF CONTROLS

1. Front Panel Controls

The front panel controls are used for turning the Remote Control unit ON or OFF; controlling the volume level of the loudspeaker, muting the speaker, changing from Radio to Intercom operation; and Tone Signal Output Control. In addition, there are the Loudspeaker, Power "ON" Indicator Light, Transmitting "operate" Indicator Light and Microphone Jack.

a. MICROPHONE JACK — This is a four pin receptacle providing connections for the microphone "hot", microphone "ground", Push-to-Talk (P/T) control and P/T ground.

b. LOUDSPEAKER — 3.5 ohms impedance with at least 2 watts audio output, less than 5% distorted, may be muted by the speaker muting switch (or handset hook switch if such is provided).

c. RADIO INTERCOM SWITCH — Depressing the radio-intercom switch permits the use of a remote control unit, with any others paralleled with it, as an Inter-Communication system. This is done without the transmission of the information by the transmitter, since the remote transmitter P/T circuit is disabled by the Radio-Intercom switch.

d. VOLUME CONTROL — A potentiometer is used to regulate the output level of the loudspeaker.

e. POWER ON/OFF SWITCH — A SPDT switch, used to apply power to the remote control unit, does not furnish power to the remote control transmitter/receiver.

f. TONE SWITCH — A spring return, momentary switch is used to disable the microphone amplifier circuit and to generate an alerting tone signal which is transmitted by the remote transmitter.

g. SPEAKER MUTING SWITCH — A spring return, momentary switch is used to shut off (disable) the speaker. The circuit is restored to normal operation, upon release of the switch.

2. Front Panel Indicators

a. POWER LIGHT — Indicates when power is applied to the Remote Control unit.

b. TRANSMIT LIGHT — Indicates when the microphone push-to-talk switch has been activated to cuase transmission.

c. VU METER — Measures and indicates the output and input levels of the telephone line. Normally the Microphone Amplifier of the Remote Control unit provides an output level of 0 to +6 db on the telephone line. A zero VU level (+8 on peaks) is the allowable input to a leased cable pair. This is required to minimize cross-talk to other circuits. Higher levels may be permitted on open lines. The Speaker Amplifier of the Remote Control unit is capable of using a signal from the remote receiver, over the telephone line of -10 db and still be able to furnish ample power for the speaker output.

C. PRELIMINARY CHECKS AND OPERATION

When the operator first comes on duty, it is recommended that he perform these following checks.

1. Turn the unit "ON" if not already in operation. Observe that the POWER LIGHT is lit, indicating that the unit has power applied to it.

2. Press the Microphone P/T switch, the TRANSMIT LIGHT should light up to indicate a transmit condition.

3. When talking into the microphone with the push-to-talk (P/T) switch closed in the transmit condition, observe that the VU meter reads normal.

4. Depress the Radio-Intercom Switch (if other Remote units are paralleled for Intercom operation) and test this circuit by talking to one or more of the other units. When operating Intercom between two or more remote control units, it is not necessary to operate the P/T Switch of the microphone, however, the Radio-Intercom Switch, S 402, must be held down (in Intercom position) while talking. The VU meter will operate when talking "Intercom".

5. The "Attention TONE" circuit may also be tested with another radio unit to determine if it functions correctly. The reading of the VU meter with Tone "ON" should be zero to plus three VU (on peaks).

6. Adjust the Volume Control for normal level of Loudspeaker output.

7. If a remote Handset and/or Loudspeaker is used, test them also for proper operation.

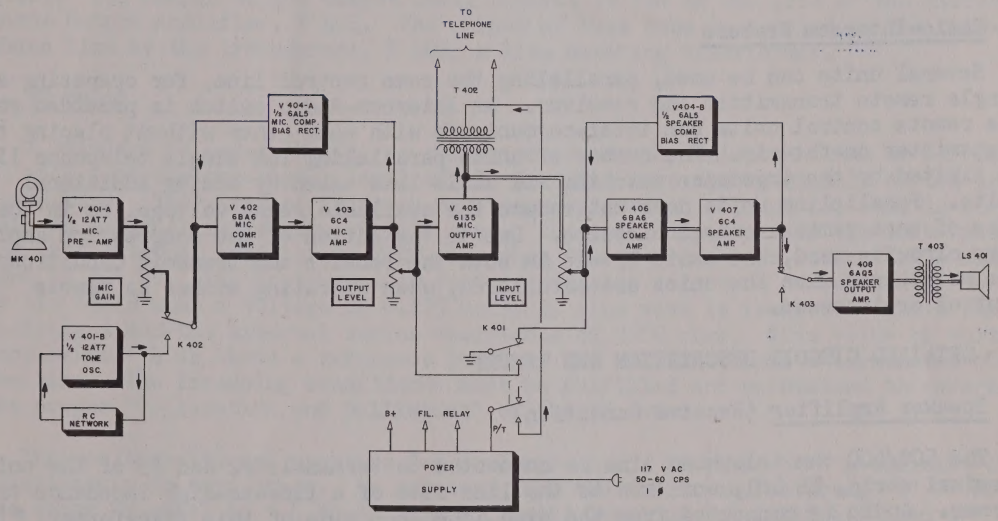

Figure 4-1. Block Diagram

SECTION IV. CIRCUIT THEORY

4. GENERAL DISCUSSION

The C-2099A/FRC-52 Remote Radio Set Control Unit consists of two separate and independent amplifiers.

1. Speaker Amplifier (Receive Condition)

Is capable of amplifying an incoming remote receiver signal from the telephone line of -10 db (or less) and furnishing ample power to the loudspeaker. A compression amplifier circuit is included in the speaker amplifier so that a variation of 25 db in the input signal level will be held to less than 3 db variation in the output level.

2. Microphone Amplifier

Has sufficient gain to utilize a transistorized pre-amplifier, controlled reluctance microphone. The microphone amplifier contains a compression amplifier circuit similar to that in the speaker amplifier mentioned above. The output of this circuitry provides an input into the telephone line of 0 VU to over +12.5 VU. The C-2099A/FRC-52 is designed to simplex the P/T circuit over a single telephone pair and earth ground. Voltage for the two amplifiers is provided by an internal power supply which furnishes B+ voltage, filament, and relay control voltages.

3. Connection To Other Equipment

When using the C-2099A/FRC-52 control unit, a single pair, metallic, telephone line is used for both the incoming receiver signal and for supplying audio to the remote transmitter. The line and earth ground also serve to provide a +24 to +60 VDC relay voltage for operating the transmitter Push-to-Talk relay (60 V available at control unit remote end). For equipment not designed for remote operation, the only additions necessary at the transmitter/receiver location are a line-to-line transformer, a sensitive 1000 to 3000 ohm DPDT telephone type relay, and a 500 ohm "T" pad.

4. Radio-Intercom Feature

Several units can be used, paralleling the same control line, for operating a single remote transmitter and receiver. An Intercom-Radio switch is provided so the remote control units can inter-communicate with each other without placing the transmitter on-the-air. The number of units paralleling the single telephone line is limited by the impedance matching and audio loss taken by adding additional units. Paralleling units does not reduce the available relay voltage, as in the case of some remote control circuits. Due to the action of the compression amplifier circuits used, the audio levels in both the receive and transmit conditions are maintained when the units are paralleled, when operating either as remote control or intercom.

B. DETAILED CIRCUIT DESCRIPTION AND THEORY

1. Speaker Amplifier (Receive Condition)

The 500/600 ohm telephone line is connected to terminals #2 and #3 of the units terminal strip, TB 401, and thus to the line side of a line-to-high impedance transformer. Audio is connected from the high impedance side of this transformer, T 402, to the Input Level Control, R 426, then to the grid of the compression amplifier, V 406. Output of the compression amplifier, V 406, is fed to fixed gain voltage amplifier V 407. Here the audio signal is split and part is used to drive the compression bias rectifier, V 404B. Delay voltage to be used on this bias rectifier is developed by the network, R 433, R 434 and R 435. When the audio signal level over-rides this delay bias, the rectifier conducts and gain reducing negative bias is put on the control grid of V 406, the Speaker Compression Amplifier. Some of the audio from the Speaker Amplifier, V 407, is fed to the arm of the Relay, K 403. From the normally closed contact of this relay, audio is applied to a voltage divider, R 444, a fixed resistor and R 450, a variable resistor. These two resistors collectively form the volume control, V 408. The Speaker Output Amplifier is able to furnish over 2 watts of audio output with less than 5% distortion to the speaker.

2. Microphone Amplifier (Transmit Condition) Input

This amplifier works with the output signal from a controlled reluctance transistorized pre-amplifier microphone. Voltage to operate the built-in transistorized

pre-amplifier circuit of the microphone is taken from the cathode circuit of V 408, the Speaker Output Amplifier. The voltage is developed in the voltage divider circuit, R 445, R 446 and R 447, then is filtered by capacitors C 248 and C 249. This remote control unit is normally furnished with a transistorized pre-amplifier microphone or may be supplied with a carbon button microphone as a replacement. Other types of microphones that do not require a voltage supply to operate them may also be used. Therefore, a jumper connection is provided on the terminal strip, TB 401, which allows this voltage to be applied if required or removed if not required. This jumper is between pins 16 and 17 of TB 401.

3. Microphone Amplifier Circuitry

V 401A, 1/2-12AT7, is the Microphone Pre-Amplifier; it is used to amplify the input signals received from the microphone sufficiently so that they can be used to drive the Microphone Compression Amplifier, V 402, and the Microphone Amplifier, V 403. The circuitry composed of V 402, V 403 and V 404A, operates in a manner similar to that of their respective counterparts in the Speaker Amplifier (receive condition) circuit (i.e., V 406, V 407 and V 404B). The output of the compressor section of the microphone amplifier circuit is fed to the Output Level Control, R 424. The output of the Output Level Control is fed to the grid of the Microphone Output Amplifier, V 405. The output of this tube is coupled to the telephone line by the transformer, T 402, a line matching transformer.

4. VU Meter

A standard VU meter, M 401, is connected across the telephone line at all times. It will indicate the signal level of all incoming or outgoing signals on the telephone line. This type of VU meter has been designed to be, and is, used in series with an external resistance of 3600 ohms. The total impedance of the instrument and this external resistor is 7500 ohms when the instrument is indicating a measurement of "0" VU. The instrument is factory adjusted to show a deflection of "0" VU on its scale when a voltage of 0.225 volts AC sine wave is impressed across the instrument and the external series resistance of 3600 ohms. This value of voltage represents + 4 db above a reference level of 1.0 milliwatt into a terminated 600 ohm line. The foregoing conditions must be fulfilled and maintained to assure the proper "Calibration and Ballistics" of the VU meter.

The positive (+) and negative (-) markings on the VU scale have a definite db relationship to each other. As received from the meter manufacturer, "0" VU on the meter is equal to + 4 db above a reference level of 1.0 milliwatt into a terminated 600 ohm line, as stated previously. Under some special conditions of operation, it may be necessary to use the remote radio set control with a higher output level. To calibrate the VU meter for this condition, the following information is provided. To accomplish the proper recording at a higher signal level, some form of attenuation of the constant impedance type must be properly selected and inserted between the VU meter and its external 3600 ohm resistance. This attenuation may take the form of either a fixed network (for a specific level) or a variable unit such as a "T" pad.

CAUTION

Never under any conditions should a single series resistor be used to change the VU meter sensitivity. To do so will destroy the VU meter's "Ballistic Calibration".

If desired, standard "Electronic Industries Association" values of resistance may be used instead of the values listed in Table 4-1, with results that are satisfactory in normal use.

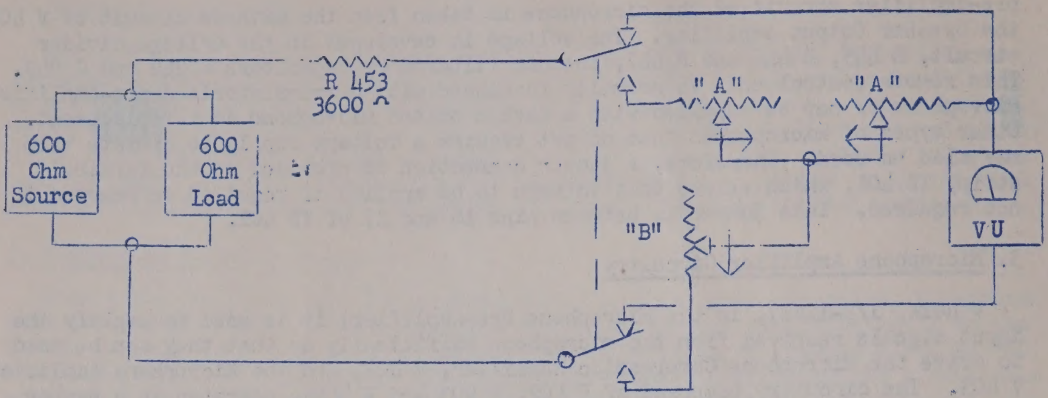

Figure 4-2. VU Meter Attenuation Circuit

Table 4-1. Attenuator Circuit Values

Attenuator Loss in DB	DB * Level	VU Level	ARM "A" In Ohms	ARM "B" In Ohms
0	- 6	4	0	Open
1	- 5	5	224.3	33801
2	- 4	6	447.1	16788
3	- 3	7	666.9	11070
4	- 2	8	882.5	8177
5	- 1	9	1093	6415
6	0	10	1296	5221
7	+ 1	11	1492	4352
8	+ 2	12	1679	3690
9	+ 3	13	1857	3166
10	+ 4	14	2026	2741
11	+ 5	15	2185	2388
12	+ 6	16	2334	2091
13	+ 7	17	2473	1838
14	+ 8	18	2603	1621
15	+ 9	19	2722	1432
16	+ 10	20	2833	1268
17	+ 11	21	2935	1124
18	+ 12	22	3028	997.8
19	+ 13	23	3113	886.3
20	+ 14	24	3191	787.8
21	+ 15	25	3262	700.8
22	+ 16	26	3326	623.5

* In DB from 1.0 milliwatt, 600 ohms

5. Audio Tone Oscillator

An attention tone or alerting tone is provided in the C-2099A/FRC-52 Remote Radio Set Control by way of a phase shift oscillator, V 401B. This tone circuit is operated by depressing the non-locking switch, S 403 (located on the front control panel). This switch actuates the tone relay, K 402, which performs two functions.

First, one set of K 402 contacts transfers the input to the Microphone Compression Amplifier, V 402, from the output of the Microphone Pre-Amplifier circuit to the input of the Audio Tone Oscillator circuit, thereby replacing the microphone input circuit with the tone oscillator circuit. The audio tone oscillator circuit is then put into the microphone compression amplifier, compression bias rectifier and microphone amplifier the same as would be the output of the microphone pre-amplifier circuit. The second set of K 402 contacts, in the relaxed, or non-energized position, shorts out the phase shift network, thereby preventing generation of the tone signal when it is not desired. When the tone switch is actuated, energizing relay K 402, the grounded transfer arm is removed from the phase shift circuit allowing it to generate the audio tone signal and is placed on the normally open contact, thereby actuating the press-to-talk circuit, allowing the tone to be transmitted over the telephone line without the operation of the push-to-talk switch.

WARNING

With an open line, when the press-to-talk switch is operated, voltage from the telephone line to ground on terminals #2 and # 3 of Terminal Board TB 1, is 250 Volts.

6. Power Supply Control Circuits

The power supply consists of the power transformer, T 401, silicon rectifiers, CR 401 through CR 404, and associated filter circuit. The primary push-to-talk voltage (P/T') for operating the two local relays (K 401 and K 403), in the C-2099A/FRC-52, is obtained from the IR voltage drop developed across Resistor, R 448, in the negative leg of the high voltage supply. This voltage, which is approximately 55 volts key up, and 48 volts key down, is for the relays actuated by the push-to-talk voltage (P/T"). The voltage actuating the remote transmitter relay is obtained from the high voltage supply through a series dropping resistor, R 428, which when connected to the remote P/T" relay applies + 24 to + 60 VDC to the telephone control circuit when the relay, K 401, is actuated. The voltage required for operating the transmitter P/T" relay is dependent upon resistance of the relay used at the remote transmitter. A sensitive telephone type relay having a resistance of 1000 to 3000 ohms should be used. Normally, current required for operating this type of relay over the telephone line will be 10 to 20 ma; which is considerably less than the maximum allowable rating permitted by a telephone company for leased control lines.

7. Relays

Three relays are provided in the C-2099A/FRC-52.

a. The DPDT P/T Relay, K 401, performs the following functions when actuated.

(1) Removes the ground connection from the input grid of V 405, the Microphone Output Amplifier. This ground connection prevents this tube from conducting, thereby preventing transmissions while in the receive condition.

(2) The input grid voltage of the Speaker Compression Amplifier, V 406, is reduced, thereby preventing this tube from conducting and providing a Speaker Amplifier output.

(3) Applies the +24 to + 60 VDC P/T" voltage to the telephone line (simplexed) for actuating the P/T relay at the remote transmitter.

(4) Applies voltage to I 402, the Transmitter Operate Indicator Light, so that it will light, indicating that the remote control unit is in the "Transmit Condition".

NOTE: The P/T" voltage will not be provided, nor will the Transmitter Indicator Light, light if the Radio/Intercom Switch, S 402, is held in the Intercom position.

b. The slow release speaker muting relay, K 403, disconnects the output of the Speaker Amplifier, V 407, from the input to the Speaker Output Amplifier, V 408, and shorts the output to ground, thus muting the Audio Output. This relay, being of the slow-release type, releases after K 401, causing the speaker circuit to remain muted until all contacts of K 401 have returned to the un-energized position. This feature is desirable to prevent a "plop" in the speaker after the Push-to-Talk switch is released.

c. The Tone Relay, K 402, is an AC type; its functioning is described in detail, above, in Paragraph 5, Audio Tone Oscillator.

SECTION V. INSTALLATION, MAINTENANCE AND REPAIR

A. LEASED TELEPHONE LINES

When using the C-2099A/FRC-52 Remote Control Unit, a single pair, metallic, telephone line is used for both the incoming receiver signal and for supplying audio to the remote transmitter. By simplexing, the line also serves to provide a +24 to +60 VDC relay voltage for operating the transmitter Push-to-Talk relay. (+60 VDC available at the control unit end). The 500/600 ohm telephone line is connected to terminals #2 and # 3 of the units terminal strip, TB 401, and is coupled to the speaker amplifier circuit by means of the Line-to-High Impedance Matching Transformer, T 402. A good earth ground MUST be connected to terminal #1 of TB 401 to provide the remote relay operation. The high impedance winding is connected to the Input Level Control, R 426, which is located on the rear vertical surface of the chassis. This is adjusted to give the maximum desired speaker level, in conjunction with the Speaker Volume Control, R 450, which is located on the front control panel, when the volume control is in the full ON position.

N O T E

A good earth ground must be provided at the transmitter and must be connected to terminal #1 of TB 401 for operation of the simplex P/T. The remote P/T relay is operated through the earth ground return.

1. Four classes of leased lines are usually available. These are:

a. Permanent Broadcast type: 200 to 4500 cycles (equalized).
b. Temporary Broadcast: 200 to 4500 cycles (equalized).
c. Equalized "talk line" for voice frequencies only: ±4 db, 300 to 2750 cycles.
d. Unequalized Voice Line.

2. A zero db level (plug 6 db on peaks) is the maximum allowable input to a leased cable pair. This level is required to minimize cross-talk to other circuits. Higher levels may be permitted on open lines.

3. The maximum permissible relay control voltage usually permitted is 130 volts. +24 to +60 volts DC is supplied by the C-2099A/FRC-52 for the remote transmitter P/T" Relay.

4. The maximum permissible relay control current usually permitted is 60 ma. A maximum of only 20 ma is required from the C-2099A/FRC-52 control unit when using a 1000 ohm telephone relay at the remote transmitter.

B. TELEPHONE LINES, DESCRIPTION OF

1. Generally, telephone lines are of three types:

a. Open lines.

b. Twisted pairs.

c. Cable pairs.

2. The open line will usually have a loss of approximately 1 db per mile and twisted pair slightly more depending on the size wire used. The loss in the latter may increase during rainy weather. The loss in a shielded cable pair will generally be higher than a., or b. With a cable pair of #22 wire, the loss may run as high as 3 db, per cable mile.

3. From the above it will be noted that the C-2099A/FRC-52 can be used to control the remote fixed station over a line, approximately 10 miles in length, using an open line or a good grade of twisted pair. Using a cable pair, the distance may be limited to 5 miles or less of cable length due to the higher losses in the latter. Of the three, the shielded cable will generally pick up the least noise or hum, with the twisted pair the next best and the open line the least desirable due to noise or hum pick-up, especially if closed to an AC power line. The general telephone practices of transposition should be followed for an open line of any distance especially if near to an AC power line. This will also reduce cross-talk if the line is parallel to other open lines.

4. If a privately owned open or twisted pair line is used, which is not leased from the telephone company, or if the open or twisted pair is separate from other audio or "talk" pairs, the audio can be operated at a higher level than the 0 db (6 db maximum on peaks) limitation usually set by the telephone company. This will help overcome the higher noise and/or hum level of the open or twisted pair. The latter, regardless of whether it is leased or privately owned, should always be limited to 0 db as a higher level will usually cause "cross-talk" to other pairs in the same cable.

5. As mentioned above, the telephone company in some locations require leasing of two pairs for remote transmitter control, one a metallic control line and the other a balanced "Talk" pair; the latter may have repeat coils or capacitors in the circuit, which does not guarantee a metallic line. The C-2099A/FRC-52, however, requires only a single metallic pair for control of the remote equipment if permitted by the Telephone Company. It is suggested that the Telephone Company be advised as to the exact requirement before leasing the remote line(s).

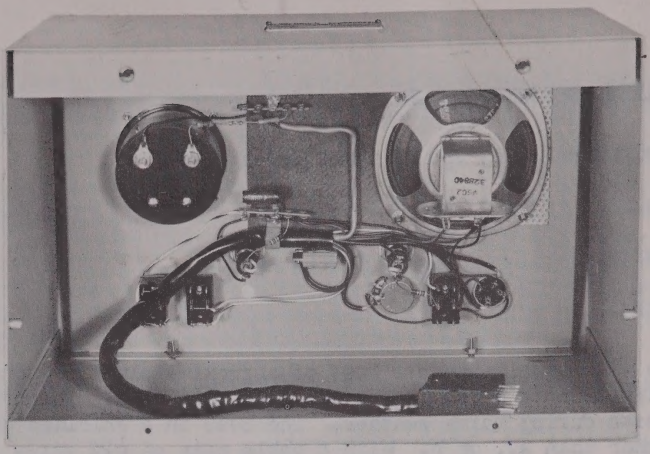

Figure 5-1. Back View of Cabinet and Control Panel

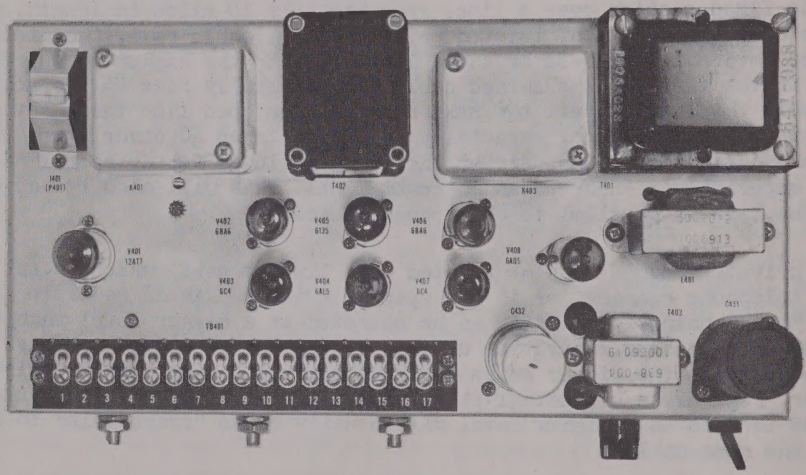

Figure 5-2. Top View of Chassis

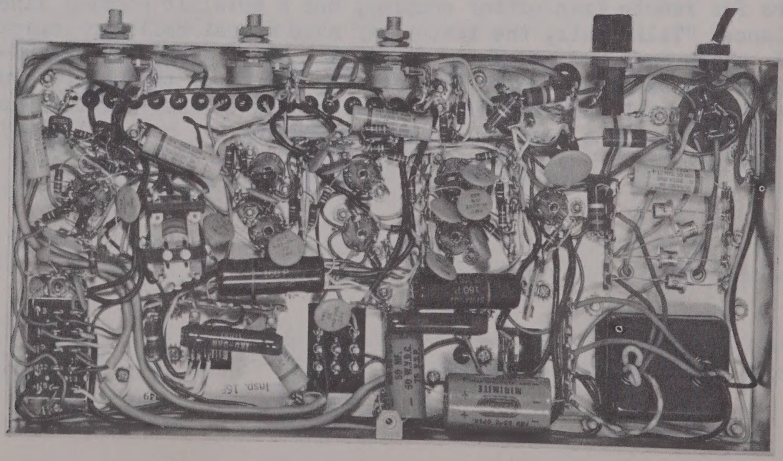

Figure 5-3. Bottom View of Chassis

C. CONNECTIONS TO A TELEPHONE LINE

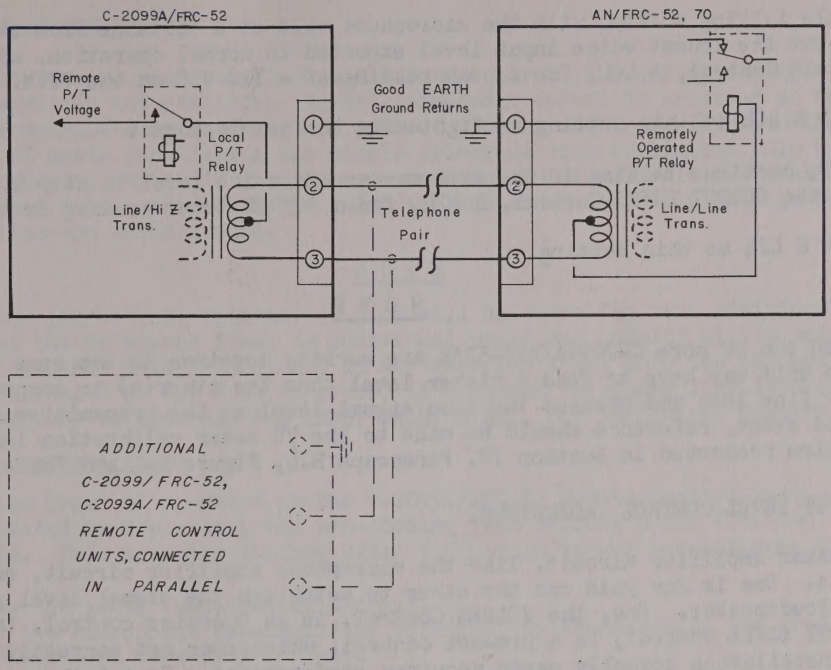

Figure 5-4. Simplified Schematic; Single Telephone Pair Connection With Earth Ground Return

D. MICROPHONE CIRCUITS AND ADJUSTMENTS

The Microphone Amplifier (transmit condition) circuit is designed to operate with an input from a transistorized pre-amplifier, controlled reluctance microphone. A carbon button microphone may be used as a satisfactory replacement without changing the circuitry. Other types of microphones can be used, providing the proper jumper changes are made for impedance and voltage requirements. If a dynamic, reluctance or crystal microphone is used, the jumper across terminal pins #16 and #17 of TB 401 must be removed. The microphone amplifier circuit contains two controls. One is for gain and the other to establish the signal level presented to the telephone line. These are not Operator controls, since once they are correctly set for a given installation, they normally never require readjustment. To correctly set these controls, proceed as follows:

1. Have the C-2099A/FRC-52 control unit connected to a terminated 500/500 ohm telephone line, preferably with the remote radio transmitter as the termination load.

2. Connect a Vacuum Tube Volt Meter (set to read negative DC voltage) with the probe on terminal #10 of TB 401, and with Meter Common lead to either terminals #1 or #15 of TB 401 (chassis ground). Terminal #10 is the Microphone Compressor Test Point.

3. Operate the Push-to-Talk switch.

4. While talking softly, with the microphone held at a distance from the lips, to represent the lowest voice input level expected in normal operation, adjust the MIC. GAIN Control, R 404, for a peak reading of - 1.0 VDC on the VTVM.

5. Lock R 404 at this setting by tightening the hex lock nut.

6. Next, continue talking in the same manner and voice level in step 4, above, and adjust the OUTPUT LEVEL Control, R 424, for a "0" VU meter reading on speech peaks.

7. Lock R 424 at this setting.

N O T E

When two or more C-2099A/FRC-52's are working together in the same system, one unit may have to feed a higher level than the other(s) to compensate for line loss and present the same signal level at the transmitter. In this event, reference should be made to the VU meter calibration information presented in Section IV, Paragraph B.4, Figure 4-1 and Table 4-1.

E. INPUT LEVEL CONTROL, ADJUSTMENT

The speaker amplifier circuit, like the microphone amplifier circuit, contains two controls. One is for gain and the other to establish the signal level presented to the loudspeaker. One, the VOLUME Control, is an Operator control, the other, the INPUT LEVEL control, is a pre-set control, which once set correctly for a given installation normally never requires readjustment. To set these controls correctly, proceed as follows.

1. Have the C-2099A/FRC-52 control unit connected to a terminated 500/600 ohm telephone line, with the remote radio transmitter as the termination load.

2. Connect a Vacuum Tube Volt Meter (set to read negative DC voltage), with the probe on terminal #11 of TB 401, and with the Meter Common lead to either terminal #1 or #15 of TB 401 (chassis ground). Terminal #11 is the Speaker Compressor Test Point.

3. Use the lowest level of input signal from the telephone line, which can be expected in normal operation.

N O T E

When operating with <u>one</u> C-2099A/FRC-52 and its remote receiver, use a weak signal from the receiver for this adjustment. When operating with <u>two or more</u> C-2099A/FRC-52 units in parallel with their remote receiver, use the signal from the unit in the system that is farthest (in terms of telephone line) from the control unit being adjusted.

4. While the desired, low level, test signal is being received, adjust R 426, the INPUT LEVEL control, for a VTVM reading of - 1.0 VDC on speech peaks.

5. Lock R 426 to hold this setting.

6. Adjust the VOLUME Control for the desired level for operation. This will vary upon the output required to —

(a) Overcome room noise;
(b) Present desired weak signals; and
(c) Operator preference and comfort.

F. RADIO-INTERCOM FEATURE

Several units can be used paralleling the same control line for operating a single remote transmitter and receiver. An Intercom-Radio switch is provided so the units can inter-communicate with each other without placing the transmitter on-the-air. The number of units paralleling the single telephone line is limited only by the impedance matching and audio loss taken by adding additional units. Paralleling units does not reduce the available relay voltage since the relay voltage is between the line and earth ground.

N O T E

An audio loss (in both directions) of 3 db will be taken for each additional unit added across the telephone line. As additional units are added it will be necessary to increase the MIC GAIN, R 404; but in any case the level into the telephone line should not exceed 0 db (or 6 db on peaks) if a leased telephone line is used. It may be neccessary to increase the INPUT GAIN, R 426, for sufficient Speaker Level.

G. AUDIO TONE OSCILLATOR

An "Attention Tone" is provided in the C-2099A/FRC-52 Remote Control Unit. The tone is actuated by depressing the non-locking TONE SWITCH, S 403 (located on the front panel). This actuates the Tone Relay, K402, which in turn accomplishes two functions:

1. Energizes the local Push-to-Talk Circuit.
2. Disables the Microphone Pre-Amplifier circuits, by transferring the grid of V 402 to the tone feed-back circuit.

Upon releasing the TONE Switch, S 403, the circuits are restored to normal.

H. MODIFYING EQUIPMENT FOR REMOTE OPERATION

For equipment not designed for remote operation, the only additions necessary at the transmitter/receiver location are a line-to-line transformer, a sensitive 1000 to 3000 ohm DPDT telephone type relay, and a 500 ohm "T" pad.

I. INSTRUCTIONS FOR ACCESS TO THE CHASSIS, AND PARTS FOR REMOVAL OR REPLACEMENT

1. Access to the Chassis

This is obtained by removing the ventilated back plate which has two DZUS fasteners on the top and rests on hinge pins on the lower sides.

2. The Chassis

The chassis may be removed by first taking off the back plate. Then removing one screw from the bottom of the cabinet (located near the front, center) and two screws from the rear of the case. After the three screws are removed, the chassis may be lifted up and out. Then, if desired, the 15 pin Jones Plug can be disconnected.

3. The Front Panel

The front panel is fastened to the cabinet by four screws and nuts, which are accessible after removing the chassis and back plate.

4. Access to the Relays

(a) Remove the two Phillips head screws from the top of the shield cans, lift off the shield cans.

(b) The third relay (TONE) is mounted underneath the chassis.

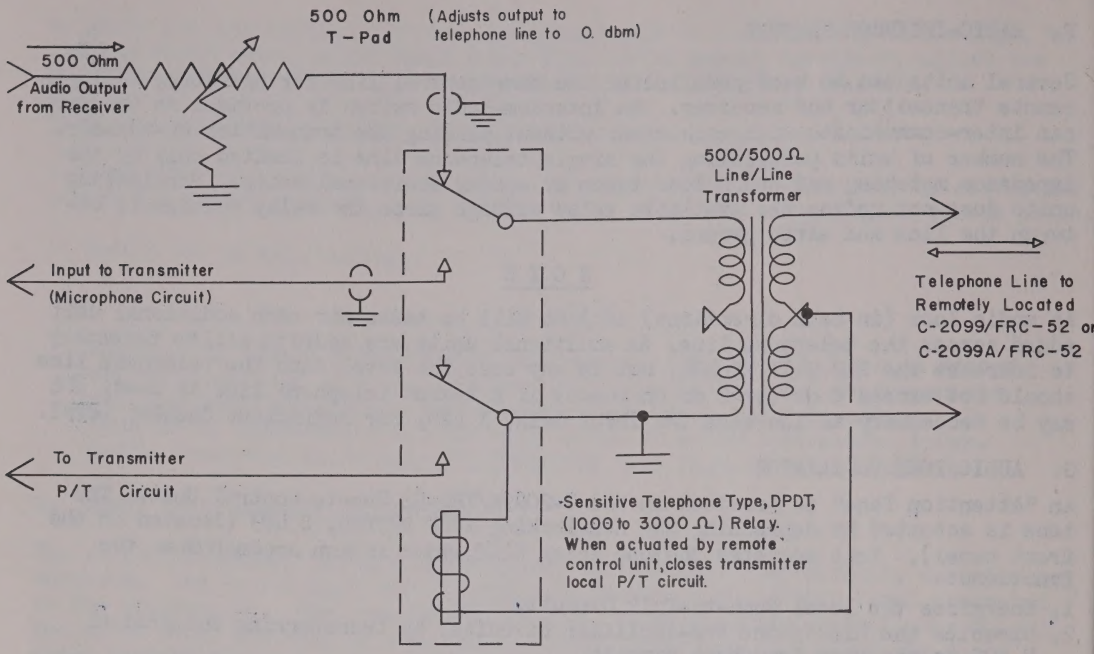

Figure 5-5. Simplified Schematic; Modification of Typical Receiver/Transmitter Unit for Remote Operation

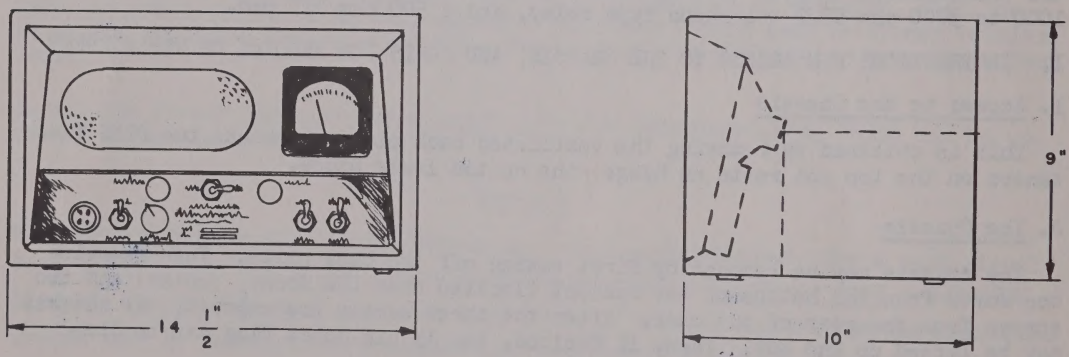

Figure 5-6. Dimensional Drawing

TYPICAL VOLTAGE READINGS, RECEIVE CONDITION

YMBOL UMBER	TUBE TYPE	FUNCTION	Pin No. 1	Pin No. 2	Pin No. 3	Pin No. 4	Pin No. 5	Pin No. 6	Pin No. 7	Pin No. 8	Pin No. 9
V 401	12AT7	Mic. Pre-Amp./ Tone Oscillator	83	0	1.9	Filament	Filament	45	- 0.8	Chassis Grounded	Chassis Grounded
V 402	6BA6	Microphone Comp. Amplifier	- 1	Chassis Grounded	Chassis Grounded	Filament	80	18	Chassis Grounded		
V 403	6C 4	Microphone Amplifier	72	N.C.	Chassis Grounded	Filament	72	0	3.4		
V 404	6AL5	Compression Bias Rectifier	15	- 0.75	Chassis Grounded	Filament	15	N.C.	- 0.75		
V 405	6135	Microphone Output Amplifier	140	N.C.	Filament	Chassis Grounded	140	0	4.85		
V 406	6BA6	Speaker Comp. Amplifier	- 1	Chassis Grounded	Chassis Grounded	Filament	68	18	Chassis Grounded		
V 407	6C 4	Speaker Amplifier	73	0	Chassis Grounded	Filament	73	0	3.5		
V 408	6AQ5	Speaker Output Amplifier	0	12.6	Filament	Chassis Grounded	250	262	0		

TYPICAL VOLTAGE READINGS, TRANSMIT CONDITION

V 401	12AT7	Mic. Pre-Amp./ Tone Oscillator	82	0	1.8	Filament	Filament	45	- 0.8	Chassis Grounded	Chassis Grounded
V 402	6BA6	Microphone Comp. Amplifier	- 1	Chassis Grounded	Chassis Grounded	Filament	80	18	Chassis Grounded		
V 403	6C 4	Microphone Amplifier	70	N.C.	Chassis Grounded	Filament	72	0	3.35		
V 404	6AL5	Compression Bias Rectifier	14	0	Chassis Grounded	Filament	14.2	N.C.	75		
V 405	6135	Microphone Output Amplifier	138	N.C.	Filament	Chassis Grounded	138	0	4.6		
V 406	6BA6	Speaker Comp. Amplifier	- 1	Chassis Grounded	Chassis Grounded	Filament	54	18	Chassis Grounded		
V 407	6C 4	Speaker Amplifier	71	N.C.	Chassis Grounded	Filament	71	0	3.3		
V 408	6AQ5	Speaker Output Amplifier	0	12.5	Filament	Chassis Grounded	248	265	0		

TYPICAL RESISTANCE READINGS

V 401	12AT7	Mic. Pre-Amp./ Tone Oscillator	110 K (5)	470 K	1000 Ω	Filament	Filament	120 K (5)	1 Meg	Chassis Grounded	Chassis Grounded
V 402	6BA6	Microphone Comp. Amplifier	4.3 Meg	Chassis Grounded	Chassis Grounded	Filament	160 K (5)	15 K	Chassis Grounded		
V 403	6C 4	Microphone Amplifier	110 K (5)	N.C.	Chassis Grounded	Filament	110 K (5)	1 Meg	3300 Ω		
V 404	6AL5	Compression Bias Rectifier	517 K	3.347 M	Chassis Grounded	Filament	517 K	N.C.	3.347 M		
V 405	6135	Microphone Output Amplifier	26.5 K (5)	N.C.	Filament	Chassis Grounded	26.5 K (5)	0	1000 Ω		
V 406	6BA6	Speaker Comp. Amplifier	4.3 Meg	Chassis Grounded	Chassis Grounded	Filament	160 K (5)	15 K	Chassis Grounded		
V 407	6C 4	Speaker Amplifier	110 K	N.C.	Chassis Grounded	Filament	110 K	1 Meg	3300 Ω		
V 408	6AQ5	Speaker Output Amplifier	0 to 500 K (4)	270 Ω	Filament	Chassis Grounded	230 Ω (5)	0 (5)	0 to 500 K (4)		

NOTES:

1. All measurements taken with a VTVM and measured to Chassis Ground, unless otherwise noted.
2. All voltage readings are positive, DC, unless otherwise noted.
3. Measurements taken without the Control Unit connected to a telephone line, but with a 1000 Ω resistor connected between pins #8 and #15 of TB 401.
4. This reading dependent upon the setting of the VOLUME Control, R 450.
5. These readings are measured to the High B+ bus (the junction of L 401, C 431B, C 431C, R 443 and R 405).

Table 5-1. Typical Voltage and Resistance Readings

COMMUNICATIONS COMPANY, Inc.
300 Greco Avenue
Coral Gables, Florida

SECTION VI

PARTS INFORMATION

For

CONTROL RADIO SET

C-2099A/FRC-52

NOTICE

For Federal Stock Numbers and Source, Maintenance and Recoverability Codes, refer to the appropriate Stock Number Identification Table (SNIT), issued by the Electronics Supply Office. The SNIT rather than this publication, shall govern if there is any conflict between stock numbers and support information.

For ease in identification and abbreviation, the five digit numbers appearing in the column headed "MFR'S CODE" are from the "Federal Supply Code for Manufacturers", and a list of these numbers will be found following the Parts List proper.

SYMBOL NUMBER	DESCRIPTION	VALUE			FUNCTION	COMCO P/N	MFR'S CODE	MFR'S PART NO.
	CAPACITORS							
C 401	Fixed, ceramic, disc type	10,000μμf	+80%-20%	600WVDC	V401A Grid Input Coupling	130-021	91418	Type B
C 402	Fixed, ceramic, disc type	10,000μμf	+80%-20%	600WVDC	V401A Plate Output Coupling	130-021	91418	Type B
C 403	Fixed, electrolytic, tubular, axial lead	10 μf	+100-0%	50WVDC	V401B Cathode Bypass	57-006	80183	TVA-1304
C 404	Fixed, mica	270 μμf	± 5%	500WVDC	V401B Grid, Tone Phase Shift Network	B82-270	84171	DM15E271J
C 405	Fixed, mica	270 μμf	± 5%	500WVDC	V401B Grid, Tone Phase Shift Network	B82-270	84171	DM15E271J
C 406	Fixed, mica	270 μμf	± 5%	500WVDC	V401B Grid, Tone Phase Shift Network	B82-270	84171	DM15E271J
C 407	Fixed, mica	270 μμf	± 5%	500WVDC	V401B Grid, Tone Phase Shift Network	B82-270	84171	DM15E271J
C 408	Fixed, mica	4 μμf	+0.5 μμf	500WVDC	V401B Output Coupler	B82-4	84171	DM15-040K
C 409	Fixed, ceramic, disc type	1000 μμf	+80%-20%	600WVDC	V401B Output Bypass	130-019	91418	Type B
C 410	Fixed, ceramic, disc type	10,000μμf	+80%-20%	600WVDC	V402 Grid Input Coupling	130-021	91418	Type B
C 411	Fixed, paper	250,000μμf	+10%	200WVDC	V402 Grid Bias Bypass	30-013	56289	2TM-P25
C 412	Fixed, ceramic, disc type	20,000μμf	+80%-20%	600WVDC	V402 Screen Grid Bypass	130-033	91418	Type B
C 413	Fixed, ceramic, disc type	2200 μμf	+80%-20%	1000WVDC	V402-V403 Coupling	130-041	91418	Type JL
C 414	Fixed, mica	500 μμf	± 5%	300WVDC	V403 Grid Bypass	B82-500	84171	DM15F501J
C 415	Fixed, electrolytic, tubular, axial lead	10 μf	+100-0%	50WVDC	V403 Cathode Bypass	57-006	80183	TVA-1304
C 416	Fixed, ceramic, disc type	2200 μμf	+80%-20%	1000WVDC	V404A Cathode, Voltage Coupling	130-041	91418	Type JL
C 417	Fixed, ceramic, disc type	10,000μμf	+80%-20%	600WVDC	V403 Output Coupling	130-021	91418	Type B
C 418	Fixed, electrolytic, tubular, axial lead	10 μf	+100-0%	50WVDC	V405 Cathode Bypass	57-006	80183	TVA-1304
C 419	Fixed, ceramic, disc type	20,000μμf	+80%-20%	600WVDC	T402 - V406 Coupling	130-041	91418	Type B
C 420	Fixed, ceramic, disc type	10,000μμf	+80%-20%	600WVDC	V406 Grid Input Coupling	130-021	91418	Type B
C 421	Fixed, paper	250,000μμf	+10%	200WVDC	V406 Grid Bias Bypass	30-013	80183	2TM-P25
C 422	Fixed, ceramic, disc type	20,000μμf	+80%-20%	600WVDC	V406 Screen Grid Bypass	130-033	91418	Type B
C 423	Fixed, ceramic, disc type	2200 μμf	+80%-20%	1000WVDC	V406 - V407 Coupling	130-041	91418	Type JL
C 424	Fixed, mica	500 μμf	± 5%	300WVDC	V407 Grid Bypass	B82-500	84171	DM15F501J
C 425	Fixed, electrolytic tubular, axial lead	10 μf	+100-0%	50WVDC	V407 Cathode Bypass	57-006	80183	TVA-1304
C 426	Fixed, ceramic, disc type	10,000μμf	+80%-20%	600WVDC	V407 Plate Output Coupling	130-021	91418	Type B
C 427	Fixed, ceramic, disc type	2200 μμf	+80%-20%	1000WVDC	V404B Cathode, Voltage Coupling	130-041	91418	Type JL

SYMBOL NUMBER	DESCRIPTION	VALUE			FUNCTION	COMCO P/N	MFR'S CODE	MFR'S PART NO.
	CAPACITORS (CONT'D)							
C 428	Fixed, electrolytic, tubular	50 µf		50WVDC	Microphone Voltage Supply Filter	57-039	80183	TVA-1308
C 429	Fixed, electrolytic, tubular, axial lead	10 µf	+100-0%	50WVDC	V408 Cathode Bypass	57-006	80183	TVA-1304
C 430	Fixed, ceramic, disc type	5000 µµf	± 10%	1000 VDC	Audio Output Transformer Primary Filter	130-040	91418	Type JL
C 431	Fixed, electrolytic, twist-lock, triple section	10µf x 10µf x 10µf		500WVDC	Power Supply Filter	62-040	83125	TMT-45
C 432	Fixed, electrolytic, twist-lock, triple section	10µf x 10µf x 10µf		500WVDC	V401A Plate B+ Bypass/V405 Plate B+ Bypass/Low B+ Bypass	62-040	83125	TMT-45
C 433	Fixed, electrolytic, tubular	50 µf		150WVDC	Relay Voltage Filter	59-022	82376	MM-50-150
CR 401	SEMICONDUCTOR DEVICE, Silicon Diode, 500 ma at 100° C., 280 VRMS; power rectifier with axial leads				Power Supply B+ Rectifier	371-029	72699	PT 540
CR 402	SEMICONDUCTOR DEVICE, Silicon Diode, 500 ma at 100° C., 280 VRMS; power rectifier with axial leads				Power Supply B+ Rectifier	371-029	72699	PT 540
CR 403	SEMICONDUCTOR DEVICE, Silicon Diode, 500 ma at 100° C., 280 VRMS; power rectifier with axial leads				Power Supply B+ Rectifier	371-029	72699	PT 540
CR 404	SEMICONDUCTOR DEVICE, Silicon Diode, 500 ma at 100° C., 280 VRMS; power rectifier with axial leads				Power Supply B+ Rectifier	371-029	72699	PT 540
E 401	INSULATOR, Sheet type; with numerical identification, 1 through 17				Used with TB 401	770-005A	71785	770-005A
E 402	INSULATOR, Wafer Type				Used with C 431	195-002	37942	BP 4
E 403	INSULATOR, Sleeve type, tubular; 1 in. dia. by 3 in. long				Used with C 431	195-004	37942	CE4-1x3
E 404	SHIELD, Can type (with mounting rods) 1-15/16 in. deep by 2-13/32 in. wide by 3-3/4 in. high by 0.020 in. thick				Used with K 401	565-019A	05776	Ordered by Size
E 405	SHIELD, Can type (with mounting rods) 1-15/16 in. deep by 2-13/32 in. wide by 3-3/4 in. high by 0.020 in. thick				Used with K 403	565-019A	05776	Ordered by Size
E 406	WASHER, Metallic, capacitor mounting				Used with C 432	195-001	37942	MP4
F 401	FUSES, Cartridge; 2 Amp; 125 V, slow-blow, 3AG size				AC Input Circuit	246-004	75915	313002
H 401	KNOB; Molded Plastic, for 1/4 in. dia. shaft				Volumn Control Knob	300-024	41226	N16-K700284-0190
I 401	LAMP; Indicator, Neon, negative glow; type NE-51				Power ON Indicator	238-006	24454	NE51

SYMBOL NUMBER	DESCRIPTION	VALUE			FUNCTION	COMCO P/N	MFR'S CODE	MFR'S PART NO.
I 402	LAMP; Indicator, Neon, negative glow; type NE-51				Transmit Indicator	238-006	24454	NE 51
J 401	CONNECTOR, RECEPTACLE, ELECTRICAL; Female, 15 contacts				Interchassis Cable Receptacle	551-112	71785	S-315-EB
J 402	CONNECTOR, RECEPTACLE, ELECTRICAL; Female, 4 contacts				Microphone Jack	551-009	02660	91-PC4F
K 401	RELAY; Telephone type, fast operate, fast release; DPDT; Contacts rated at 3A, 150W; Coil, 1000 ohms DC				P/T Relay	388-032	71482	Type C
K 402	RELAY; DPDT; Contacts rated at 5A, 115 VAC; Coil, 5.1 ohms DC resistance, 372 ma at 6.3 VAC				Tone Relay	388-044	77342	KA 11A
K 403	RELAY; Telephone type, slow release; SPDT, Contacts mated at 3A, 150 watts; coil, 500 ohms; 8450 turns, #35 E.C. wire				Speaker Muting Relay	386-019	71482	Type E
L 401	COIL, Filter Choke; 50 ma, 200 ohms DC resistance, 4.5 henries				Power Supply Filter Choke	500-032	74042	C-2977
LS 401	LOUDSPEAKER; Permanent magnet type; 5 in. dia.				Front Panel Speaker	575-009	80331	SP5C
M 401	METER, Audio Level; Scale reads -20 to +3 V 3&0 to 100%; 600 ohms impedance				VU Meter	315-072	06555	Mod. 15 Scale A
MK 401	MICROPHONE, Controlled, Reluctance, Transistorized Pre-Amplifier; Desk Type; with P/T switch, with cable, W 402, and Plug, P 402				Desk Microphone	325-014A	54715	CR20SLT
P 401	CONNECTOR, PLUG, ELECTRICAL; male, 15 contacts				Interchassis Plus	551-113	71785	P-315-CCT
P 402	CONNECTOR, PLUG, ELECTRICAL; male, 4 contacts				Microphone Cable	345-017	02660	91-MC4M
	RESISTORS							
R 401	Fixed, composition	1 Meg	±10%	1/2W	V401A Grid Bias	404-1Meg	01121	EB 1051
R 402	Fixed, composition	10 K	±10%	1 W	V401A Plate B+ Dropping Isolation	406-10K	01121	GB 1031
R 403	Fixed, composition	100 K	±10%	1/2W	V401A Plate B+ Dropping	404-100K	01121	EB 1041
R 404	Variable, composition w/ locking device, JAN Type "C" Taper	75 K	±20%	1/4W	Microphone Gain Control	475-201	71450	45 (LT)
R 405	Fixed, composition	100 K	±10%	1/2W	V401B Plate B+ Dropping	404-100K	01121	EB 1041
R 406	Fixed, composition	1 K	±10%	1/2W	V401B Cathode Bias	404-1K	01121	EB 1021
R 407	Fixed, composition	470 K	± 5%	1/2W	V401B Grid, Tone, Phase Shift Network	404-470K-5%	01121	EB 4745
R 408	Fixed, composition	470 K	± 5%	1/2W	V401B Grid, Tone, Phase Shift Network	404-470K-5%	01121	EB 4745
R 409	Fixed, composition	470 K	± 5%	1/2W	V401B Grid, Tone, Phase Shift Network	404-470K-5%	01121	EB 4745
R 410	Fixed, compsoition	470 K	± 5%	1/2W	V401B Grid, Tone, Phase Shift Network	404-470K-5%	01121	EB 4745
R 411	Fixed, composition	1 Meg	±10%	1/2W	V402 Grid Bias	404-1Meg	01121	EB 1051
R 412	Fixed, composition	3.3 Meg	±10%	1/2W	V402 Grid Bias	404-3.3M	01121	EB 3351

SYMBOL NUMBER	DESCRIPTION	VALUE			FUNCTION	COMCO P/N	MFR'S CODE	MFR'S PART NO.
	RESISTORS (CONT'D)							
R 413	Fixed, composition	47 K	±10%	1/2W	V404A Plate	404-47K	01121	EB 4731
R 414	Fixed, composition	470 K	±10%	1/2W	V404A Cathode	404-470K	01121	EB 4741
R 415	Fixed, composition	470 K	±10%	1/2W	V404A Cathode	404-470K	01121	EB 4741
R 416	Fixed, composition	47 K	±10%	1/2W	V404A Cathode	404-47K	01121	EB 4731
R 417	Fixed, composition	150 K	±10%	1/2W	V402 Plate B+ Dropping	404-150K	01121	EB 1541
R 418	Fixed, composition	100 K	±10%	1/2W	V402 B+ Dropping	404-100K	01121	EB 1041
R 419	Fixed, composition	15 K	±10%	1/2W	V402 Screen Grid B+ Dropping	404-15K	01121	EB 1531
R 420	Not Used							
R 421	Fixed, composition	1 Meg	±10%	1/2W	V403 Grid Bias	404-1Meg	01121	EB 1051
R 422	Fixed, composition	3300 ohms	±10%	1/2W	V403 Cathode Bias	404-3300	01121	EB 3321
R 423	Fixed, composition	100 K	±10%	1/2W	V403 B+ Dropping	404-100K	01121	EB 1041
R 424	Variable, composition w/ locking device, JAN Type "C" Taper	500 K	±30%	1/4W	Output Level Control	475-206	71450	45 (LT)
R 425	Fixed, composition	1 K	±10%	1/2W	V405 Cathode Bias	404-1K	01121	EB 1021
R 426	Variable, composition w/ locking device, JAN Type "C" Taper	75 K	±20%	1/4W	Input Level Control	475-201	71450	45 (LT)
R 427	Fixed, composition	22 K	±10%	2 W	V405 Plate B+ Dropping	408-22K	01121	HB 2231
R 428	Fixed, wire wound	10 K	±10%	10 W	P/T" Voltage Dropping	420-10K	44655	BROWN DEVIL
R 429	Fixed, composition	1 K	±10%	1 W	K401, Coil Voltage Balancing	406-1K	01121	GB 1021
R 430	Fixed, composition	1 Meg	±10%	1/2W	V406 Grid Bias	404-1Meg	01121	EB 1051
R 431	Fixed, composition	3.3 Meg	±10%	1/2W	V406 Grid Bias	404-3.3M	01121	EB 3351
R 432	Fixed, composition	47 K	±10%	1/2W	V404B Plate	404-47K	01121	EB 4731
R 433	Fixed, composition	470 K	±10%	1/2W	V404B Cathode	404-470K	01121	EB 4741
R 434	Fixed, composition	470 K	±10%	1/2W	V404B Cathode	404-470K	01121	EB 4741
R 435	Fixed, composition	47 K	±10%	1/2W	V404B Cathode	404-47K	01121	EB 4731
R 436	Fixed, composition	150 K	±10%	1/2W	V406 Plate B+ Dropping	404-150K	01121	EB 1541
R 437	Fixed, composition	100 K	±10%	1/2W	V406 B+ Dropping	404-100K	01121	EB 1041
R 438	Fixed, composition	15 K	±10%	1/2W	V406 Screen Grid B+ Dropping	404-15K	01121	EB 1531
R 439	Not Used							
R 440	Fixed, composition	1 Meg	±10%	1/2W	V407 Grid Bias	404-1Meg	01121	EB 1051
R 441	Fixed, composition	3300 ohms	±10%	1/2W	V407 Cathode Bias	404-3300	01121	EB 3321
R 442	Fixed, composition	100 K	±10%	1/2W	V407 Plate B+ Dropping	404-100K	01121	EB 1041
R 443	Fixed, composition	10 K	±10%	2 W	Low B+ Dropping	408-10K	01121	HB 1031
R 444	Fixed, composition	220 K	±10%	1/2W	V408 Grid Bias Divider	404-220K	01121	EB 2241
R 445	Fixed, composition	270 ohms	±10%	2 W	V408 Cathode Bias	408-270	01121	HB 2711

SYMBOL NUMBER	DESCRIPTION	VALUE			FUNCTION	COMCO P/N	MFR'S CODE	MFR'S PART NO.
	RESISTORS (CONT'D)							
R 446	Fixed, composition	1 K	±10%	1/2W	Microphone Voltage Divider	404-1K	01121	EB 1021
R 447	Fixed, composition	1 K	±10%	1/2W	Microphone Voltage Divider	404-1K	01121	EB 1021
R 448	Fixed, wire wound	1 K	±10%	10 W	Relay Voltage Divider	420-1K	44655	BROWN DEVIL
R 449	Fixed, wire wound	4 ohms	±20%	5 W	Speaker Muting Load	420-4	44655	BROWN DEVIL
R 450	Variable, composition, JAN Type "C" Taper	500 K	±30%	1/4W	Volume Control	475-141	71450	EY 2536-45
R 451	Fixed, composition	470 K	±10%	1/2W	I402 B+ Dropping	404-470K	01121	EB 4741
R 452	Fixed, composition	470 K	±10%	1/2W	I401 B+ Dropping	404-470K	01121	EB 4741
R 453	Fixed, composition	3600 ohms	± 5%	1/2W	M401 Series Load	404-3600-5%	01121	EB 3625
S 401	SWITCH; Toggle, DPDT; on - none - momentary on				Speaker Muting Switch	525-006	04009	81057
S 402	SWITCH; Toggle, DPDT; on - none - momentary on				Radio - Intercom Switch	525-006	04009	81057
S 403	SWITCH; Toggle, DPDT; on - none - momentary on				Tone Switch	525-006	04009	81057
S 404	SWITCH; Toggle; SPST				Power ON-OFF Switch	521-001	04009	20994-IH
T 401	TRANSFORMER, Power; step up, step down, 117 VAC Input				Power Supply	641-038	Fischer Elec. Co., Box 518 DeLeon Springs, Fla.	10065946
T 402	TRANSFORMER, Line to Grid; Multiple Shielded				600 Ohm Telephone Line to High Impedance Matching	614-012	33324	Type T-6
T 403	TRANSFORMER, Audio Output, 4 ohms and 500 ohms output impedance				Audio Output Transformer	638-004	97965	88A3
TB 401	TERMINAL BOARD, Barrier style; 17 screw and Solder Lug Type Terminals				Chassis Rear, Telephone Line Termination, Test Points & Jumpers	676-045D	71785	17-140Y
V 401	TUBE, ELECTRON; Type 12AT7				Microphone Pre-Amplifier/Audio Tone Oscillator	720-12AT7	24454	12AT7
V 402	TUBE, ELECTRON; Type 6BA6				Microphone Compression Amplifier	720-6BA6	24454	6BA6
V 403	TUBE, ELECTRON; Type 6C4				Microphone Amplifier	720-6C4	24454	6C4
V 404	TUBE, ELECTRON; Type 6AL5				Microphone Compression Bias Rectifier Speaker Compression Bias Rectifier	720-6AL5	24454	6AL5
V 405	TUBE, ELECTRON; Type 6135				Microphone Output Amplifier	720-6135	24454	6135

SYMBOL NUMBER	DESCRIPTION	VALUE	FUNCTION	COMCO P/N	MFR'S CODE	MFR'S PART NO.
V 406	TUBE, ELECTRON; Type 6BA6		Speaker Compression Amplifier	720-6BA6	24454	6BA6
V 407	TUBE, ELECTRON; Type 6C4		Speaker Amplifier	720-6C4	24454	6C4
V 408	TUBE, ELECTRON; Type 6AQ5		Speaker Output Amplifier	720-6AQ5	24454	6AQ5
W 401	CABLE, Power; Electrical, 9 ft. long		AC Line Cord and Plug	345-010A	70331	2109
W 402	CABLE, Microphone		P/O MK 401			
XF 401	HOLDER, FUSE; extractor type, 3AG		Used with F 401	250-003	75915	342003
XI 401	HOLDER, LAMP		Used with I 401	360-041A	72765	101-N
XI 402	HOLDER, LAMP		Used with I 402	360-041A	72765	101-N
XV 401	SOCKET,ELECTRON TUBE; miniature, 9 pin unshielded		Used with V 401	558-019	91662	274-PHSPDT
XV 402	SOCKET,ELECTRON TUBE; miniature, 7 pin unshielded		Used with V 402	556-013	91662	108-PHSPDT
XV 403	SOCKET,ELECTRON TUBE; miniature, 7 pin unchielded		Used with V 403	556-013	91662	108-PHSPDT
XV 404	SOCKET,ELECTRON TUBE; miniature, 7 pin unshielded		Used with V 404	556-013	91662	108-PHSPDT
XV 405	SOCKET,ELECTRON TUBE; miniature, 7 pin unshielded		Used with V 405	556-013	91662	108-PHSPDT
XV 406	SOCKET,ELECTRON TUBE; miniature, 7 pin unshielded		Used with V 406	556-013	91662	108-PHSPDT
XV 407	SOCKET,ELECTRON TUBE; miniature, 7 pin unshielded		Used with V 407	556-013	91662	108-PHSPDT
XV 408	SOCKET,ELECTRON TUBE; miniature, 7 pin unshielded		Used with V 408	556-013	91662	108-PHSPDT

TABLE 6-2.

LIST OF MANUFACTURERS

CODE NUMBER	NAME	ADDRESS
01121	Allen Bradley	Milwaukee, Wisconsin
02660	American Phenolic Corp. (Amphenol)	Chicago, Illinois
04009	Arrow Hart & Hegeman Electric Company	Hartford, Conn.
05776	Barnes Metal Products	Chicago, Illinois
06555	Beede Instrument Company	Pennacook, N. H.
24454	General Electric Company Tube Dept.	Syracuse, New York
33324	Kenyon Transformer Company, Inc.	New York, N. Y.
37942	Mallory, P. R. and Company, Inc.	Indianapolis, Ind.
41226	Molded Insulation Company	Philadelphia, Penn.
44655	Ohmite Manufacturing Company	Skokie, Illinois
54715	Shure Brothers, Inc.	Chicago, Illinois
56289	Sprague Electric Company *	North Adams, Mass.
70331	Alpha Wire Corporation	New York, N. Y.
71450	Chicago Telephone Supply Company	Elkart, Indiana
71482	C. P. Clare and Company	Chicago, Illinois
71785	Cinch Manufacturing Corp.	Chicago, Illinois
72699	General Instrument Corp.	Newark, New Jersey
72765	Drake Manufacturing Company	Chicago, Illinois
74042	Merit Coil and Transformer Corp.	Chicago, Illinois
75042	International Resistance Co., Inc.	Philadelphia, Penn.
75915	Littlefuse, Inc.	Des Plaines, Illinois
77342	Potter and Brumfield, Inc.	Princeton, Indiana
80331	Utah Radio Products Company	Huntington, Indiana
82376	Astron Company	East Newark, N. J.
83125	Pyramid Electric Company	North Bergen, N. J.
84171	Arco Electronics, Inc.	New York, N. Y.
91418	Radio Material Corp.	Chicago, Illinois
91662	Elco Sales Company	Philadelphia, Penn.
97965	Chicago Standard Transformer Co.	Chicago, Illinois
* 80183	Sprague Products Company	North Adams, Mass.

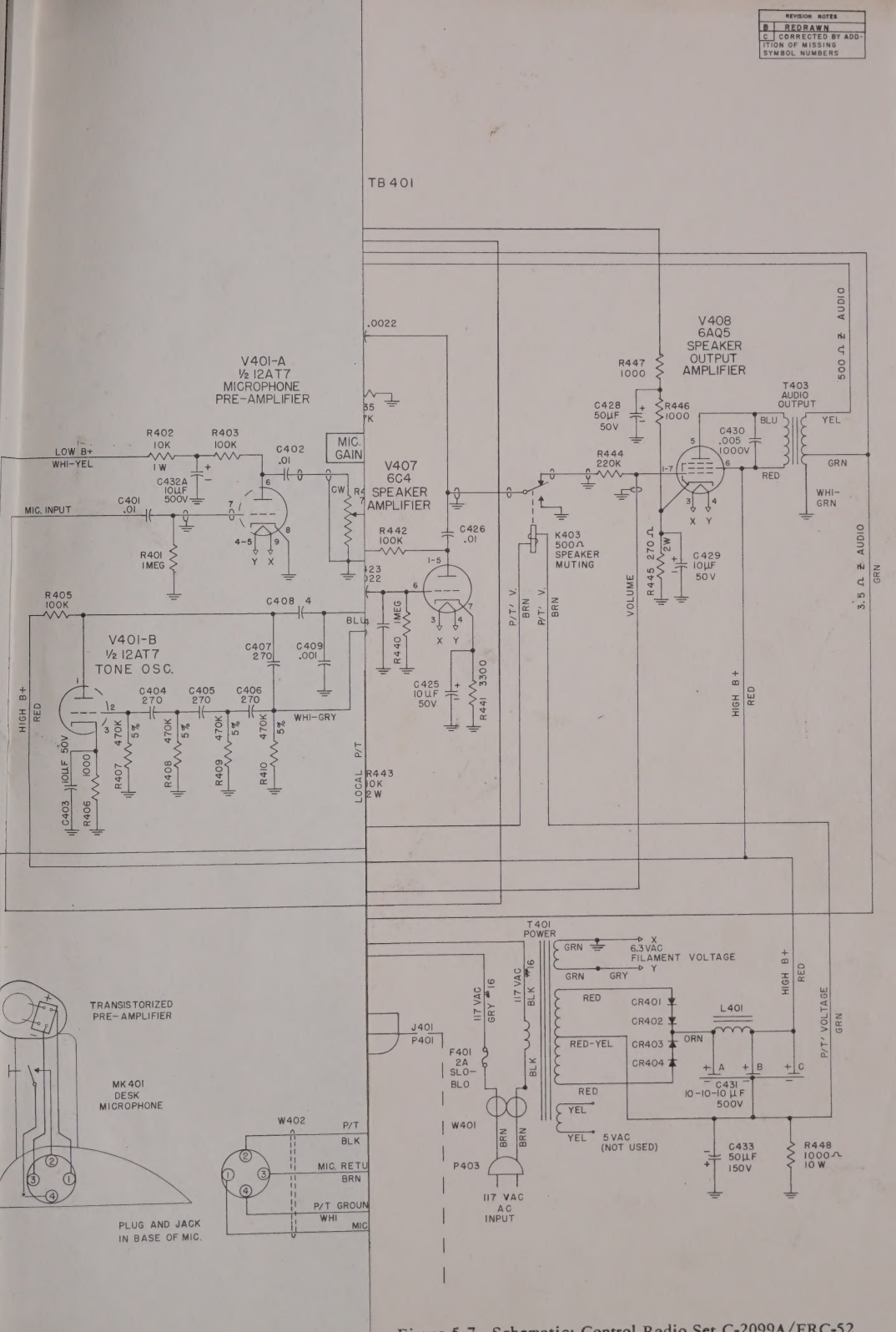

Figure 5-7. Schematic; Control Radio Set C-2099A/FRC-52

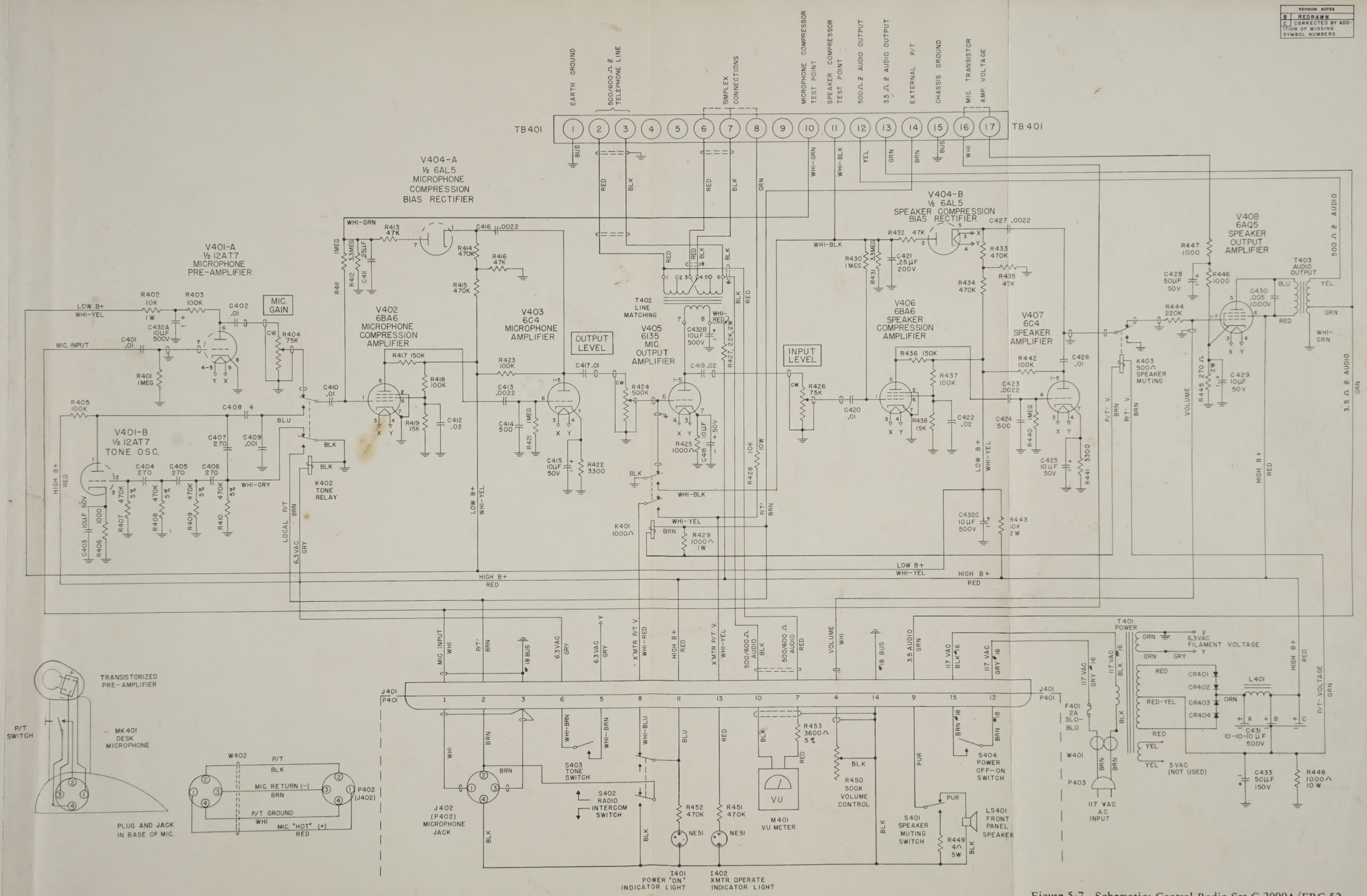

Figure 5-7. Schematic; Control Radio Set C-2099A/FRC-52